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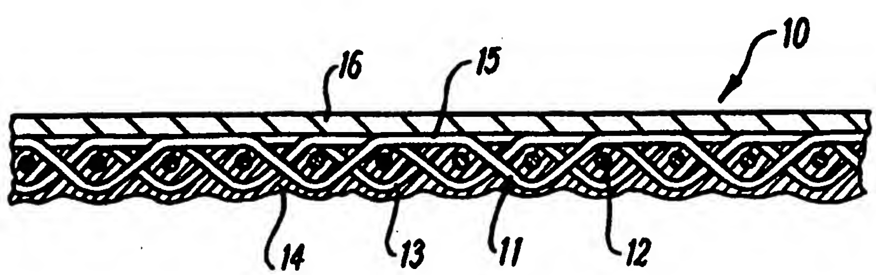
(54) Title: PHASE–SEPARATION MEMBER



(57) Abstract

A phase–separation member comprises a porous substrate (11) containing void spaces, a microporous polymer material (14) which at least partially impregnates the porous substrate by entering into the void spaces, and a layer of a fluoropolymer applied to the outer face of the coagulated polymer material so that the layer (16) of fluoropolymer material remains predominantly at the surface.

PHASE-SEPARATION MEMBER

This invention relates to improvements in phase-separation etc. members, in particular solid-liquid industrial separation, filter media such as filter cloths or filter belts, for all recognised pressure and vacuum filtrations systems, such as, rotary drum filters, belt filter presses, etc. The term phase-separation members also includes papermaking fabrics such as forming fabrics, press felts, dryer fabrics or transfer fabrics. The invention also relates to corrugator belts and conveyor belts. These members are preferably water permeable.

It is known for such members particularly but not exclusively in the case of filters and papermaking fabrics, to provide a substrate, for example of a woven fabric, a spiral link fabric, a sintered sheet, a needlefelt or nonwoven textile, or a porous film. Such members are often made from or include fibres or particles of a low surface energy material such as a polyolefin, typically polypropylene.

To improve properties of the filter or papermaking fabric, such as filter cake release, it is desirable to be able to coat the substrate with a fluoropolymer such as PTFE. However, low surface energy materials such as polyolefins bond very poorly to fluoropolymers, and as a result durable release coatings are difficult to achieve on substrates of the kind mentioned.

An object of the invention is to provide an improved phase-separation

member or the like in which a durable bond is achievable between a low-surface energy substrate material, and a fluoropolymer.

According to the invention, a phase-separation member or the like comprises a porous substrate having void spaces therein, a microporous polymer material at least partially impregnating said porous substrate by entering at least partially into said void spaces, and being substantially embedded in the substrate, and a fluoropolymer layer applied to the outer face of said coagulated polymer material such that the fluoropolymer layer remains predominantly at the surface.

The microporous layer can be of any synthetic or natural polymer which can be disclosed in a solvent, for example a polyurethane, silicone , fluoroelastomer or rubber.

The porous substrate may comprise or include particles, yarns or fibres of a low surface energy material such as a polyolefin, especially polypropylene. The porous substrate may be in the form of any of the substrates listed hereinbefore, i.e. woven or nonwoven fabric, knitted structures, needlefelt fabric, porous film, sintered sheet of metal or synthetic particles or fibres, or spiral link fabric.

All the above substrate structures include void space into which the coagulated polymer can at least partially penetrate. Preferably the substrate structure is impregnated to a substantial extent, e.g. to half or more than

half the thickness of the substrate and provides a coating not only over the substrate but within the void space, of the yarns, fibres, or particles forming the substrate to provide a filter medium of much finer pore size than would be provided by the substrate unaided. Advantageously, the coagulated polymer impregnates the substrate completely or substantially completely, and may encapsulate the substrate, i.e. provide a coating on both major surfaces as well as impregnating the substrate.

The fluoropolymer used in coagulation or to coat the substrate after impregnation of the latter with the coagulated polymer may comprise a synthetic fluorinated elastomer such as polymers or copolymers of vinylidene fluoride; pentafluoropropene; tetrafluoroethylene; hexafluoropropene; e.g. vinylidene fluoride-pentafluoropropene-tetrafluoroethylene terpolymer, or vinylidene fluoride-hexafluoropropene-tetrafluoroethylene terpolymer. Fluoropolymers such as tetrafluoroethylene PTFE or other fluoro-alkene polymers however may be used.

The coagulatable polymer may be a relatively low viscosity material, in the range 300-1000cP, e.g. of about 500 cP, and have a relatively high solids content. The low viscosity enables the polymer to penetrate substantially into the substrate structure, entering into the voids or interstices between fibres, yarns or particles making up the substrate.

The coating and impregnating layer of coagulatable polymer may be

applied to the substrate as the polymer is coagulating, for example using DMF in a 5-30% solids solution. The coagulated polymer is typically a low surface energy polymer.

Coagulation may be achieved by heating the impregnated coated textile substrate in the presence of a heat coagulant. Suitable heat coagulants include vinyl alkyl ethers and derivatives thereof; polyacetals; polythio ethers; poly (ethylene oxide) and derivatives thereof; and poly (propylene/ethylene oxide) and derivatives thereof. Heating to a temperature of about 70°C is sufficient to effect coagulation.

An alternative method of coagulation is by adding a suitable electrolyte and/or varying the pH of the polymer latex. For example, with cationic polymers, coagulation may occur at an alkaline pH and for anionic polymers coagulation occurs at an acidic pH.

The coagulatable or coagulating polymer may be applied by any coating technique such as knife coating, dip-coating, screen printing or spraying, padding or using reverse roller techniques.

The fluoropolymer coating is in turn preferably applied to the outer surface of the coagulated polymer coated substrate by lick coating, spraying, foaming or paste spreading as a particulate dispersion, with for example 40-70 wt% solids and particle size 0.1-0.5 microns, onto the receiving surface and then the liquid component of the dispersion (which is

preferably water for environmental reasons) is removed e.g. by evaporation pressing in a mangle, or suction into a slot, to leave a well-bonded low surface energy coating. Consolidation of the fluoropolymer coating can be improved by calendering the coated fabric to consolidate the structure, thereby improving retentivity (i.e. capture of filtrate particles) and smoothness (for better cake release).

The smooth fluoropolymer coating provides the microporous structure and any yarn knuckles or floats proud of said structure with enhanced abrasion resistance, as well as providing the fabric with good cake release properties. Filtrate particles are captured in the coagulated polymer forming the microporous structure.

Bodies such as hollow glass microbeads may be used to fill voids in the substrate, in place of or in addition to the coagulated polymer.

The microporous polymer material may be obtained by sintering, reticulation or mechanical or chemical blowing or foaming of a suitable material.

The coagulated polymer may be applied at a weight of 20-200 g/m^2, producing a coated substrate (made from e.g. a polyolefin, polyester, polyamide, or PAN), with a weight of 50-2000 g/m^2, before calendering.

A number of possible embodiments of phase-separation or the like members according to the invention will now be described, by way of

example, with reference to the accompanying drawings, wherein:-

Figure 1 is an enlarged fragmentary cross section of a filter belt in accordance with the invention, incorporating a woven textile fabric substrate;

Figure 2 is a similar view to Figure 1 of a papermachine fabric incorporating a spiral link fabric substrate;

Figure 3 is a similar view of a filter fabric incorporating a substrate formed of a sheet of sintered particles;

Figure 4 is a similar view of a papermachine press felt, having a substrate of a nonwoven textile fabric; and

Figure 5 is a similar view of a member incorporating a porous film substrate, which may be used in any of the above uses, or for example as a conveyor belt.

In Figure 1, a belt 10 is shown which may be suitable for use as a filter belt. This comprises a woven substrate 11, shown diagrammatically as comprising CD yarns 12 and MD yarns 13 interwoven therewith, in a typical float and knuckle pattern. The substrate 11 is impregnated with a coagulated polymer material 14, as shown by cross-hatching.

The upper side floats 15 of the MD yarns 13 are however exposed above the material 14, which thereby presents a wear resistant surface proud of the coagulated polymer layer 14. The layer 14 extends below the

fabric 11, and partially encapsulates the fabric on this lower side.

The floats 15, and the layer 14 of coagulated polymer material is coated with a layer 16 of a fluoropolymer material. This promotes release of any material such as filter cake collecting on the surface of the layer 16.

Figure 2 shows a papermachine belt 20 having a spiral link fabric substrate 21, which is partially impregnated with a layer 22 of a coagulated polymer material, which is in turn coated on an upper surface with a layer 23 of a fluoropolymer material. The layer 22 may be reinforced with a woven or nonwoven layer, or a fibrous batt as commonly used in the structure of composite papermachine belts.

Figure 3 shows a filter fabric 30, comprising a substrate 31 comprised of sintered particles or beads of solid or porous polymer material, that is partially melted under pressure so that contacting surfaces of the particles or beads are bonded on resetting of the polymer, leaving voids and interstices between the particles. Other sintered materials, such as metals, or thermoplastic fibres may be used for substrate 31.

Substrate 31 is coated and partially impregnated with a layer 32 of a coagulated polymer material, which penetrates into the voids and interstices of substrate 31 to at least half way through the thickness of the substrate, as shown by cross-hatching in the drawing. In turn, layer 32 is coated with a coating layer 33 of a fluoropolymer material.

In Figure 4, a papermachine press felt 40 comprises a substrate 41 formed of a fibrous nonwoven batt or layer. A coagulated polymer layer 42 is provided on the substrate 41, and penetrates into the interstices of the fabric, between fibres to impregnate the substrate 41 to a substantial extent, as suggested by cross-hatching. The layer 42 may completely impregnate the substrate 41.

A fluoropolymer coating 43 is applied to the layer 42.

Figure 5 shows a further embodiment of material 50 according to the invention which may be used as suggested in any of the above described embodiments, or for example in conveyor belting. This material 50 comprises a substrate 51 of a porous (e.g. foamed) membrane of plastics material, which is rendered water permeable by its porous nature. The substrate 51 is coated with a layer 52 of coagulated polymer material, which penetrates into the porous structure of the substrate 51, although this cannot be conveniently illustrated in the drawing. Layer 52 is coated in its turn with a layer 53 of a fluoropolymer.

In the foregoing embodiments, the coagulated polymers, the fluoropolymer coatings, and the materials of the substrates are selected from the examples set out earlier in the above description.

CLAIMS

1. A phase-separation member comprising a porous substrate having void spaces therein; a microporous polymer material at least partially impregnating said porous substrate by entering into said void spaces, the substrate being substantially embedded in the microporous material.

2. A phase-separation member according to claim 1 further comprising a layer of a fluoropolymer applied to the outer face of said coagulated polymer material, such that the layer of fluoropolymer material remains predominantly at the surface.

3. A phase-separation member according to claim 2, wherein the microporous layer is of a natural or synthetic polymer which can be dissolved in a solvent.

4. A phase-separation member according to claim 3, wherein the polymer is any one of a polyurethane, a silicone, a fluoroelastomer, or a rubber.

5. A phase-separation member according to any preceding claim wherein the porous substrate comprises or includes particles, yarns, or fibres of a very low surface energy material.

6. A phase-separation member according to claim 5, wherein the low surface energy material is a polyolefine.

7. A phase-separation member according to claim 5, wherein the porous substrate comprises any one of a woven or nonwoven fabric, a knitted or a needle felt fibre, a porous film, a sintered sheet of metal or synthetic particles, or a spiral link fabric.

8. A phase-separation member according to claim 2, wherein the substrate structure is impregnated to half or more than half of the thickness of the substrate and the polymer material provides a coating not only over the substrate, but within the void space, to provide a filter medium of much finer pore size than the substrate.

9. A phase-separation member according to claim 8, wherein the coagulated polymer impregnates the substrate completely or substantially completely.

10. A phase separation member according to claim 9, wherein the coagulated polymer encapsulates the substrate, and provides a coating on both major surfaces and impregnates the substrate completely.

11. A phase separation member according to claim 2, wherein the fluoropolymer used to coat the substrate after impregnation thereof comprises a synthetic fluorinated elastomer.

12. A phase separation member according to claim 11, wherein said fluoropolymer is any one of:- a polymer or copolymer of vinylidene

fluoride; pentafluoropropene; tetrafluoroethylene; or hexafluoropropene.

13. A phase separation member according to claim 12, wherein the polymer or copolymer of vinylidene fluoride is any one of:- vinylidenefluoride-pentafluoropropene-tetrafluoroethylene terpolymer; or vinylidene fluoride-hexafluoropropene-tetrafluoroethylene terpolymer.

14. A phase separation member according to claim 2, wherein the coagulatable polymer is a relatively low viscosity material, in the range 300-1000cP. and has a relatively high solids content.

15. A phase separation member according to claim 14, wherein the coagulatable polymer is applied to the substrate as the polymer is coagulating using DMF in a 5-30% solids solution.

16. A phase separation member according to claim 15, wherein coagulation is achieved by heating the impregnated coated textile substrate in the presence of a heat coagulant which is any one of:- a vinyl-alkyl ether or a derivative thereof; a polyacetal; a polythio-ether; or a poly(ethylene oxide) or a derivative thereof.

17. A phase separation member according to claim 15, wherein coagulation is achieved by adding an electrolyte and/or varying the pH of the polymer latex.

18. A phase separation member according to any preceding claim, wherein the fluoropolymer coating is applied to the outer surface of the coagulated polymer coated substrate as a particulate disperum of 40-70 weight % solids and particle size 0.1-0.5 microns, and the liquid component of the disperum removed, and the coating consolidated by calendering.

19. A phase separation member according to claim 18, wherein hollow glass microbeads are used to fill voids on the substrate.

20. A phase separation member according to claim 15 where the coagulatable polymer is applied at a weight of 20-200 g/m^2 producing a coated substrate having a weight of 50-2000 g/m^2 before calendering.

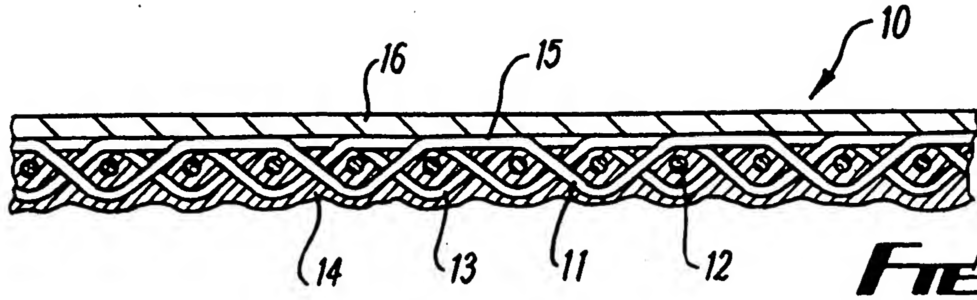


FIG. 1

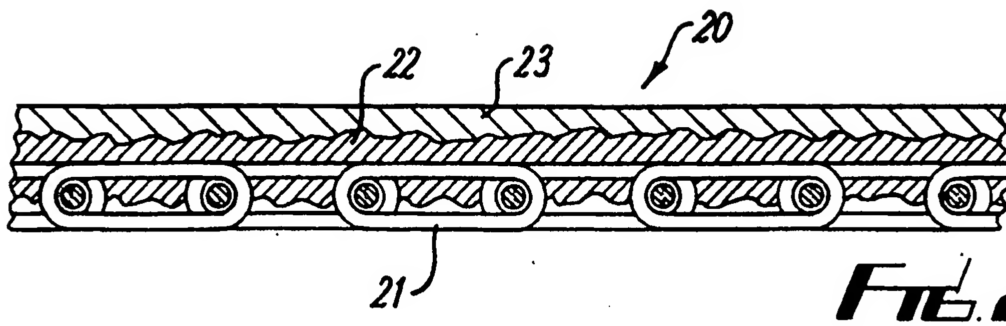


FIG. 2

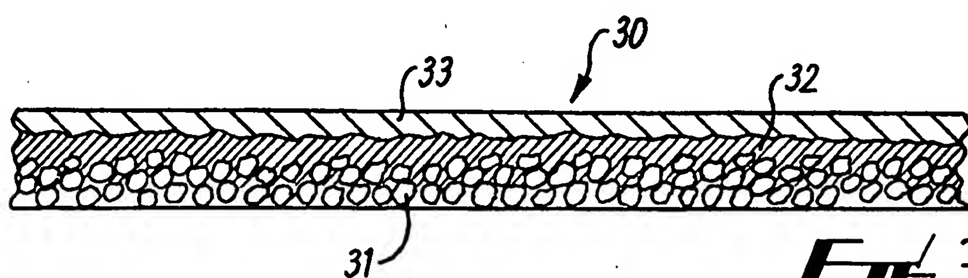


FIG. 3

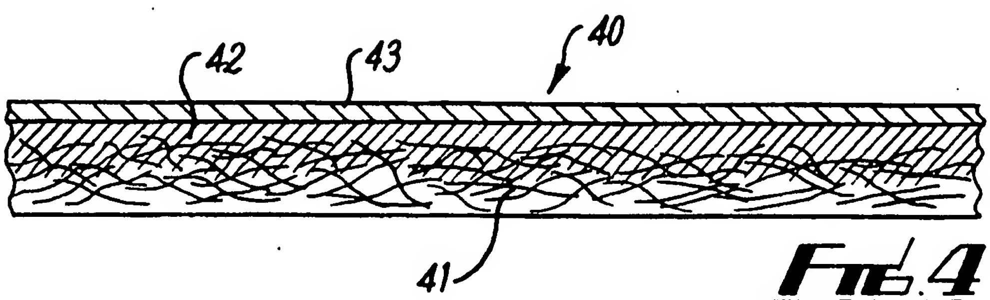


FIG. 4

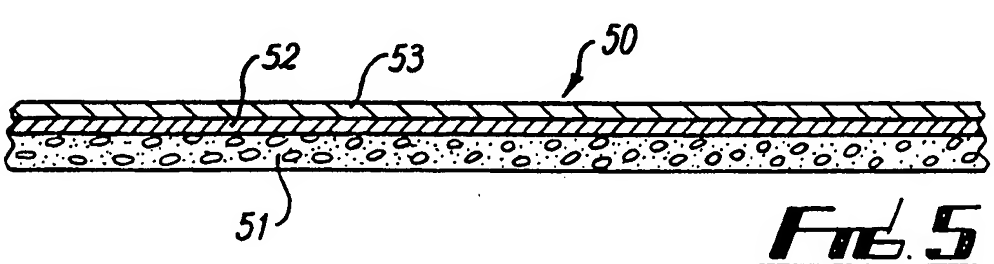


FIG. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/01421

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B01D39/08 D21F7/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B01D D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
7 September 1999	14/09/1999

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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